Project Report: Dating Earliest Life from Akilia Island, Greenland

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Project Progress

New mapping, geochronology, and geochemistry of supracrustal rocks on Akilia Island, Greenland, support a >3800 Ma age and chemical sedimentary origin for controversial Fe–rich quartz–pyroxene rocks that have been reported to contain evidence for early life. Supracrustal lithologies comprise laterally continuous, mappable units of mafic amphibolite, ultramafics, and two Fe–rich quartz–pyroxene units. Map relations support the interpretation that quartz–pyroxene rocks were part of a predeformational volcano–sedimentary stratigraphy, but are inconsistent with alternative hypothesis of an origin as metasomatic veins. U–Pb ion–microprobe measurements of zircons indicate a minimum formation age of 3600 Ma for the quartz–pyroxene rock and a possible metasedimentary block in amphibolite gneisses. A >3800 Ma depositional age of Akilia supracrustals has previously been inferred based on controversial crosscutting relations involving orthogneiss in the high–strain portion of the supracrustals. We identified two new crosscutting metatonalites. Ion–microprobe measurements of zircon cores yielded 3746±11 Ma and 3835±31 Ma ages and Th/U zircon consistent with igneous growth in the bulk composition from which they were extracted. Low bulk Zr minimizes the possibility of zircon inheritance. Ion–microprobe depth–profiling study of a single zircon from the older orthogneiss yields an igneous core age of 3825±8 Ma, and shows an episode of zircon growth at 3731±10 Ma, which may have occurred during contact metamorphism at the time of emplacement of the second tonalitic sheet. These results support a >3825 Ma depositional age of the Akilia supracrustals. As an alternative to a chemical sedimentary origin for Fe–rich quartz–pyroxene rocks, it has been proposed that the pyroxene–rich bands are metasomatized ultramafic rocks and that quartz–rich bands are metamorphosed quartz veins. However, we find a large contrast in whole–rock d 18 O between the quartz–pyroxene rock (12.6 ‰) and adjacent metaigneous units (7–8 ‰) that argues against significant mass transfer. Moreover, immobile trace elements, Rare Earth Element (REE) patterns, S isotopes and PGE data are consistent only with an origin as hydrothermal deposits chemically sedimented in a volcanic/hydrothermal setting with minor, locally derived ultramafic and mafic detrital components. These results validate the interpretation that the quartz–pyroxene rock of the Akilia supracrustals is >3800 Ma metasediment.

Highlights

- New mapping and geochronology confirm >3.8 Ga origin of chemical sediment in west Greenland . Results are described in a paper submitted to American Journal of Science.
- Manning led a NAI–sponsored field trip to examine evidence for >3.8 Ga life on Earth. Seventeen field–trip participants traveled to west Greenland in June 2004 to visit key early life localities and discuss their origin in the field and in sessions held in the capitol city of Nuuk .

Roadmap Objectives

- ***Objective No. 4.1:*** Earth's early biosphere